

Referee review of the proposal

**“Search for new physics in the charged lepton sector”**

After the discovery of the Higgs boson, the last missing piece in the Standard Model (SM), at the LHC in 2012, the leading experiments in particle physics have focused on searches for new physics beyond the Standard Model and its precision tests of the SM. The proposed experiment is at the forefront of international research in the study of charged-lepton flavor-violating (CLFV) processes. It will utilize high intensity muon beams at J-PARC (Japan) to search for CLFV in the coherent neutrino-less conversion of a muon into an electron in the field of an aluminum nucleus  $\mu^-N(A,Z) \rightarrow e^-N(A,Z)$ , with a discovery sensitivity for a variety of new physics models, including SUSY, Extra Dimensions, Double Higgs, etc. Upon its completion, the COMET experiments will improve the existing upper limit of the branching ratio by a huge factor of 10000 aiming to reach a single event sensitivity (SES) of about  $10^{-17}$ .

The experiment will be realized in two periods. The initial goals (2022-2024) are to study muon beam contamination, to measure the background and to search for  $\mu^- \rightarrow e^-$  conversion at an intermediate sensitivity in order to reach SES at the level of  $3.1 \times 10^{-15}$ . It will be a factor of 100 improvement over the existing limit. The JINR group actively participates in the preparation of the experiment setup. It has carried out R&D and production dedicated to the major components of the COMET detector. A set of 2700 thin wall straw tubes of 9.8 mm diameter for the tracker system has already been produced and tested. Careful measurements of the light output of individual LYSO crystals for electromagnetic calorimeter have been done on over 250 samples and 200 certificates have been prepared. The JINR group is also leading in R&D for the development of the Cosmic-Ray Veto (CRV) system and FE electronics. Many improvements were proposed and tested for preparation for the production of “Module-0”.

In 2022-2024 the group will finalize assembling and commissioning of the straw tube tracker and will perform the R&D program on a brand-new 5mm tube with 12 $\mu$ m wall thickness, production of the full-scale prototype (1000 pcs) and straw station. Mass-production of straw tubes for the final configuration of the detector should be done by the end of 2024. Certification of the LYSO crystals will continue as well as the development and optimization of the crystal calibration methods. The JINR group will also participate in the beam tests of the detector components, in the installation and maintenance of the major detector subsystems, in data acquisition and analysis of the data taken in the engineering and physics runs.

In the past years the JINR team has demonstrated a high level of competence and quality of the hardware they have produced. The contributions of the JINR group to various important subsystems of the detector are acknowledged and imprinted in the election of the group member as the COMET-CRV leader. These excellent achievements are very important for the success of the experiment resulting in high visibility of the JINR team.

The composition of the JINR group is well balanced showing 21 FTE per 31 members with clearly defined duties. A very nice and important achievement of the group is that 1/3 of the team are students and junior researchers.

*Although the group is doing well in R&D and production of the major systems, more responsibility could be taken by the team members in the detector simulation program and in realization of the physics program. It is not clear from the Proposal which "theoretical issues" and "physical analysis" are being pursued.*

*Some other points should also be considered:*

- *Are there any estimate of the limits that can be reached by other competitors by the end of 2024 when COMET Phase-I will be completed?*

- *What are the advantages of Al foil in COMET over the gold one used at PSI?*

- *The Proposal noted "considerable uncertainty in pion production rate". Are there any numbers and what are the implications for SES sensitivity?*

In conclusion, I consider that the continuation of the JINR participation in this challenging experiment is justified by its scientific merits and significant contribution which the JINR team has already made. There is no doubt that all the obligations taken by JINR will be fulfilled. The requested resources, including travel budgets, are suited for the completion of the detector subsystems production and the participation of the team members in the detector assembling and commissioning.

I recommend approval of the JINR participation in the COMET experiment for the period of 2022-2024 with first priority and would like to wish a big success to this strong team.



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